

Bacteria TMDL Development

For

**the Upper Rappahannock River,
Unsegmented Estuaries in E23,
Piscataway Creek,
Little Carter Creek,
Garrett's Marina and
Mark Haven Beach**

Public Meeting #2

Warsaw, VA

December 14, 2009



THE Louis Berger Group, INC.

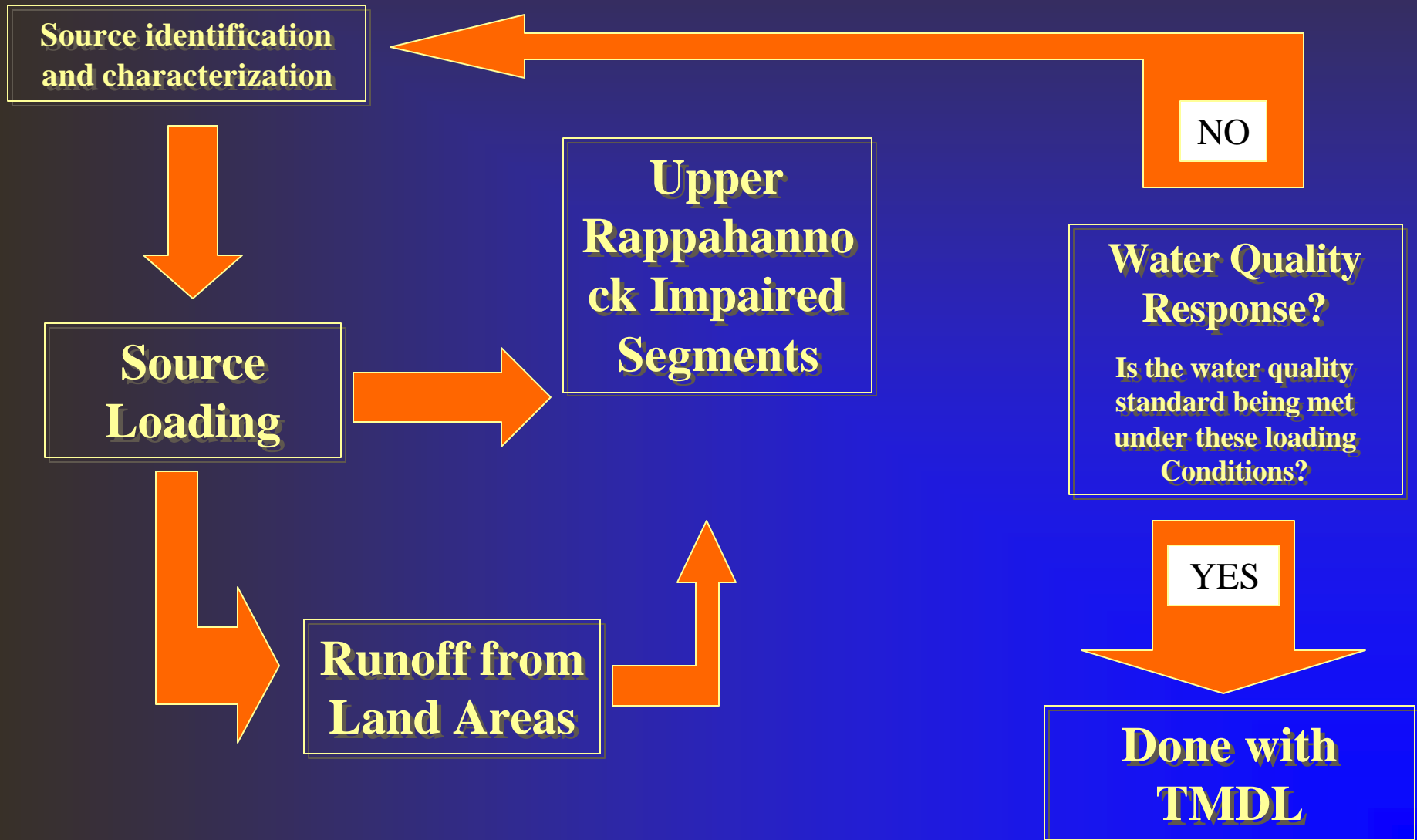
Agenda

- **Meeting Objective**
- **Recap of the 1st Public Meeting**
- **Draft Bacteria TMDL Allocation**

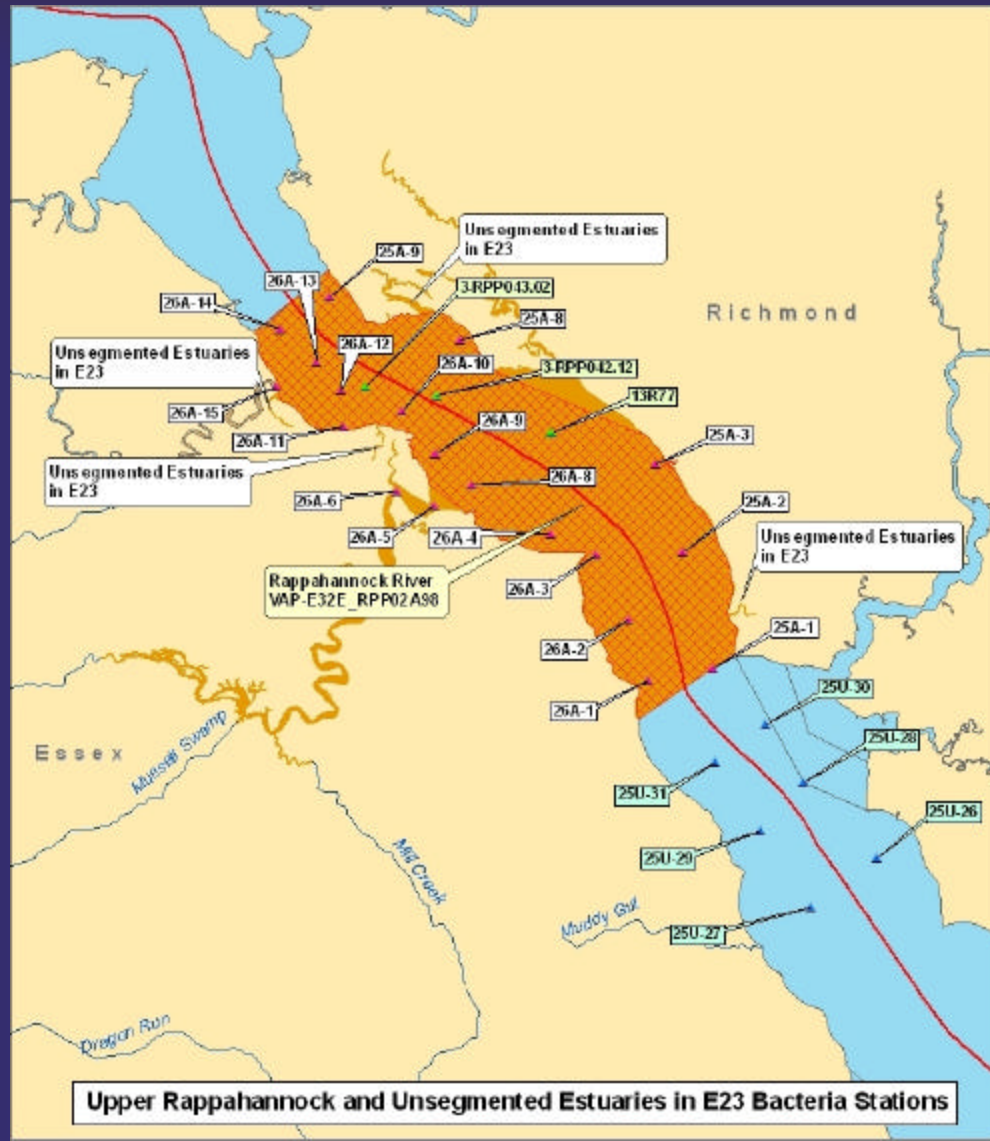
Objective

- To present and review the steps and the data used in the development of a Bacteria TMDL for the Upper Rappahannock River, Unsegmented Estuaries in E23, Piscataway Creek, Little Carter Creek, Garrett's Marina and Mark Haven Beach
- To present the draft bacteria TMDL allocations

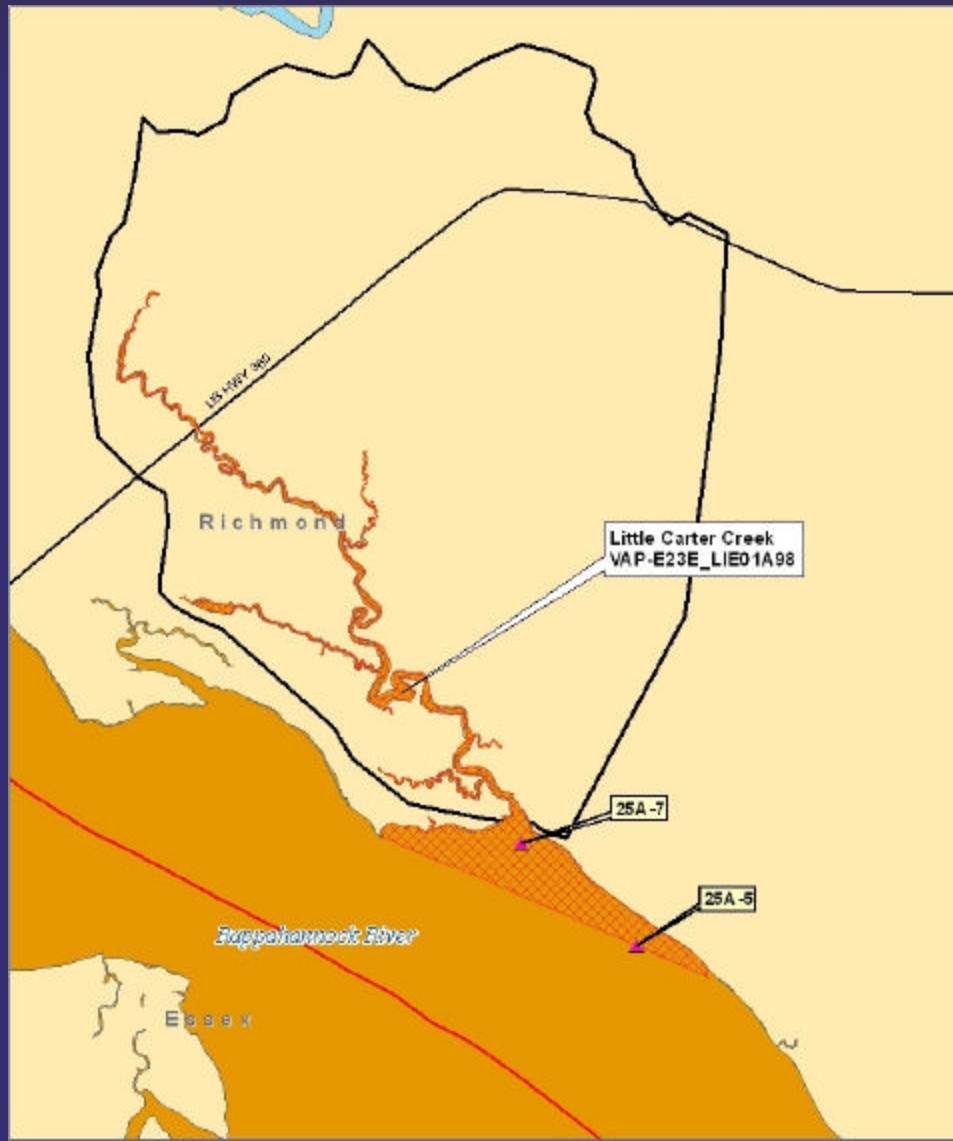
TMDL Development Process



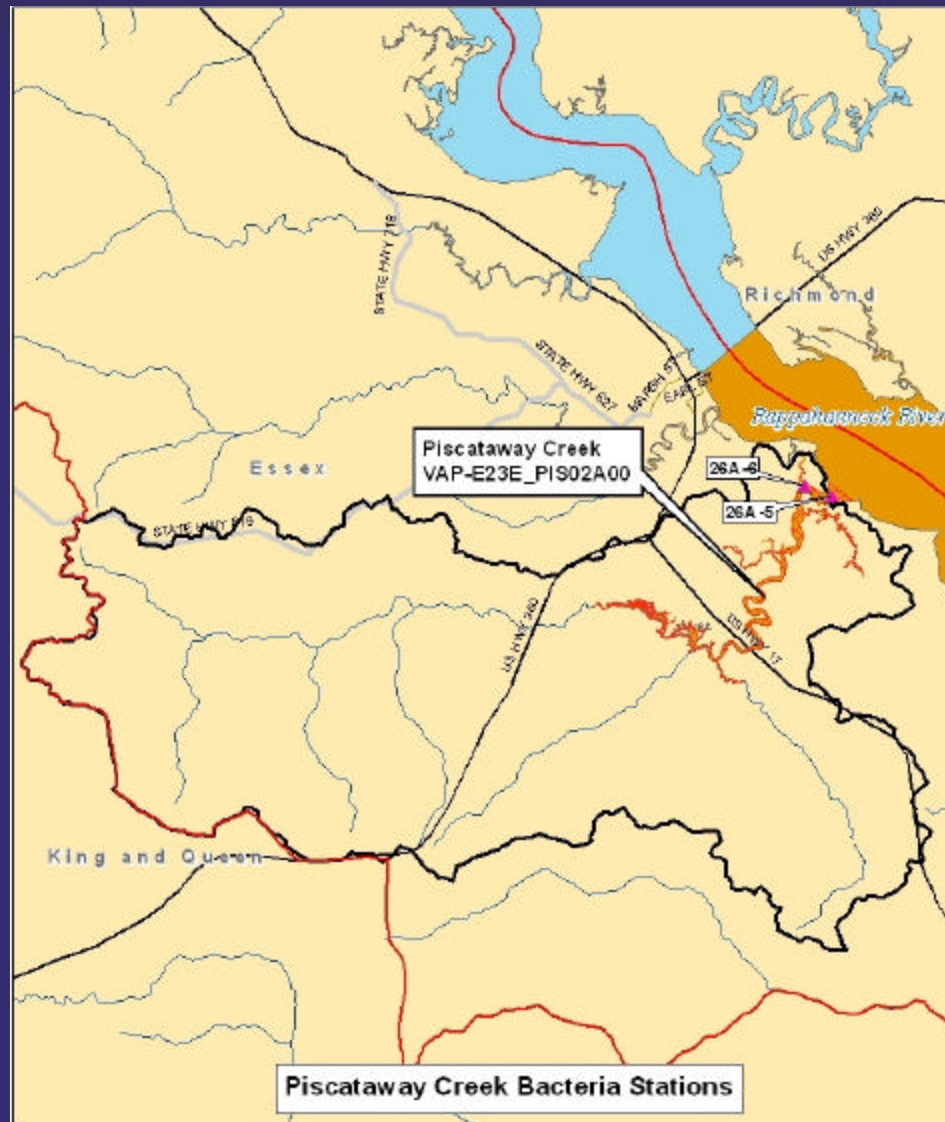
Bacteria Impaired Segments and Water Quality Stations: Upper Rappahannock River



Bacteria Impaired Segments and Water Quality Stations: Little Carter Creek



Bacteria Impaired Segments and Water Quality Stations: Piscataway Creek



Bacteria Impaired Segments and Water Quality Stations: Garrett's Marina and Mark Haven Beach



Water Quality Standards

VADEQ specifies the following bacteria criteria to protect shellfish uses (VA DEQ, 2006):

- **Fecal Coliform**
 - Geometric Mean:
 - 14 cfu/100mL
 - 90th Percentile:
 - 49 cfu/100mL

Technical Approach:

Simplified Volumetric Tidal Model

- **Used for small watersheds**
- **Incorporates point and non-point sources**
- **EPA accepted**
- **Time independent**
- **Uses a mass balance approach over a tidal period (~12 hrs)**
- **Assumes a completely mixed system (no density, concentration, and volume variations)**

Linking Sources to Water Quality

Input

Maximum bacteria concentration in the estuary

Maximum bacteria concentration at boundary (mouth of the estuary)

Volumes of water entering the bay, water flowing out of the bay, and net freshwater

Total daily bacteria die off rate



Model

Simplified Volumetric Tidal Model

Mass balance approach over an average tidal period (~12 hrs)

Completely mixed system (no density and concentration variations)



Output

Total Bacteria Load Capacity in the Condemned Estuary

- Existing Load
- Allocated Load

Watershed Characterization

Overview of the Upper Rappahannock River Watershed



Total Area: 307,421 acres

Three Counties:

➤ **Essex, Richmond, Westmoreland**

➤ **Major Cities:**

➤ **Tappahannock, Center Cross, Paul's Crossroads, Warsaw, Haynesville, Farnham, Champlain, Montross**

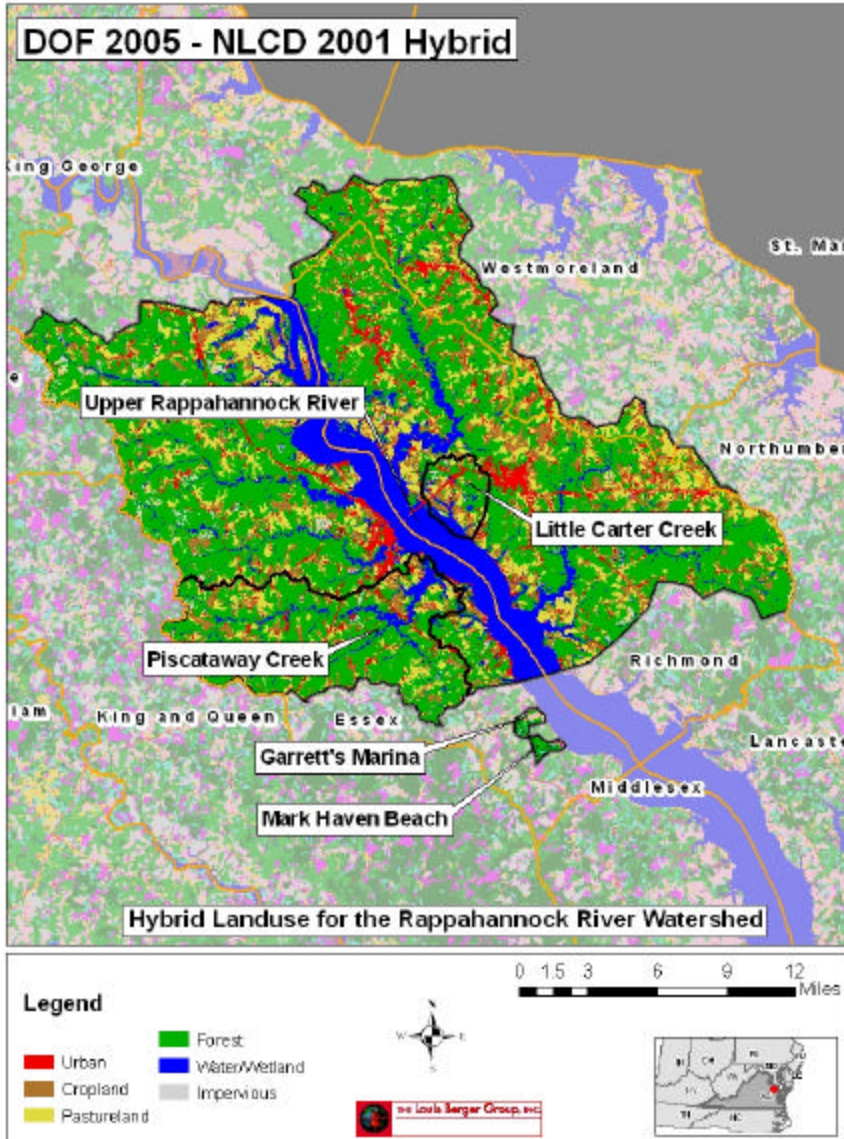
Major Roads:

➤ **Highway 3, 17, 360, 618, 627**

Main tributaries:

➤ **Hoskins Creek, Piscataway Creek, Little Carter/Jugs Creek**

Watershed Landuse



Used the most recent land use data: Hybrid of NLCD 2001 and VA Department of Forestry 2005

Total Area: 307,421

Urban: 9 % (26,756 acres)

Water/Wetland: 12 % (39,005 acres)

Agriculture: 25 % (77,580 acres)

Forest: 53% (163,727 acres)

Data from VA Department of Forestry 2005 and NLCD 2001

Potential Bacteria Sources

- **Human Sources** (septic “failing or improperly functioning” systems, straight pipes)
- **Biosolids** (when applied improperly)
- **Livestock**
- **Wildlife**
- **Pets**

Septic Failures and Straight Pipes by Watershed

Population Estimates per TMDL Watershed

By TMDL watershed	Population ¹	Number of Houses ²	Number of Houses Public Sewer ³	Number of Houses on Septic Systems ³	Number of Houses on "Other Means" ³	Number of Houses with a Failing Septic System ⁴
Piscataway	2,212	4833 ⁵	162	599	51	72
Little Carter	296	122	14	80	9	10
Garrett's	44	117 ⁵	3	12	1	1
Mark Haven	43	277 ⁵	3	12	1	1
Upper Rapp	20,719	5762 ⁵	1,561	7,208	628	865

¹ 2008 US Census Estimate

² 2007 US Census

³ 1990 US Census

⁴ Based on a septic failure rate of 12% (VA DEQ 2005)

⁵ Based on counts from the Essex County E-911 document

Livestock Estimates by Watershed



Livestock Present per TMDL Watershed					
By TMDL watershed	Cattle	Pigs	Poultry	Horses	Sheep
Piscataway	237	52	21	26	N/A
Little Carter	36	1	10 ¹	0	N/A
Garrett's	5	1	0	1	N/A
Mark Haven	5	1	0	0	N/A
Upper Rapp	779	86	617	38	18
¹ Based on comments from the town of Warsaw, VA					
N/A = Not Available					

Wildlife Estimates by Watershed

Wildlife Densities for each TMDL Watershed

Upper Rappahannock River and Unsegmented Estuaries in E23 Watershed

County	Acres	Canadian Geese	Black Duck	Wood Duck	Mallard	Deer*	Raccoon	Beaver	Muskrat
Richmond	108,641	419	0	142	406	3,240	1,398	543	13,605
Essex	128,673	503	0	170	487	3,880	1,567	563	12,944
Westmoreland	26,017	105	0	36	102	820	292	96	67
Northumberland	1,191	5	0	2	5	40	5	3	2,409
TOTAL	264,522	1,032	0	349	1,000	7,980	3,262	1,205	29,025

Little Carter and Jugs Creek

County	Acres	Canadian Geese	Black Duck	Wood Duck	Mallard	Deer	Raccoon	Beaver	Muskrat
Richmond	4,472	36	0	7	19	154	199	33	831

Piscataway Creek

County	Acres	Canadian Geese	Black Duck	Wood Duck	Mallard	Deer	Raccoon	Beaver	Muskrat
Essex	32,002	269	0	50	144	1,140	6,582	166	4,159

Garrett's Marina

County	Acres	Canadian Geese	Black Duck	Wood Duck	Mallard	Deer	Raccoon	Beaver	Muskrat
Essex	829	5	0	1	3	22	47	3	81

Mark Haven Beach

County	Acres	Canadian Geese	Black Duck	Wood Duck	Mallard	Deer	Raccoon	Beaver	Muskrat
Essex	701	5	0	1	3	20	32	3	73

Pets Estimates by Watershed

Pet Inventory per TMDL Watershed			
By TMDL watershed	Households	Dogs	Cats
Piscataway	4,833	2,624	2,866
Little Carter	122	66	72
Garrett's	117	64	69
Mark Haven	277	150	164
Upper Rapp	5,762	3,129	3,417
Source: American Veterinary Medical Association (AVMA)			

Pet inventories based on:

- Cats: 0.598 per household and
- Dogs: 0.543 per household

American Veterinary Medical Association
(AVMA) estimates

Point Sources



Total No. of Facilities: 22

Individual Permitted Facilities:

Permit Type	Number of Facilities
Municipal	1
VPDES	8
Total	9

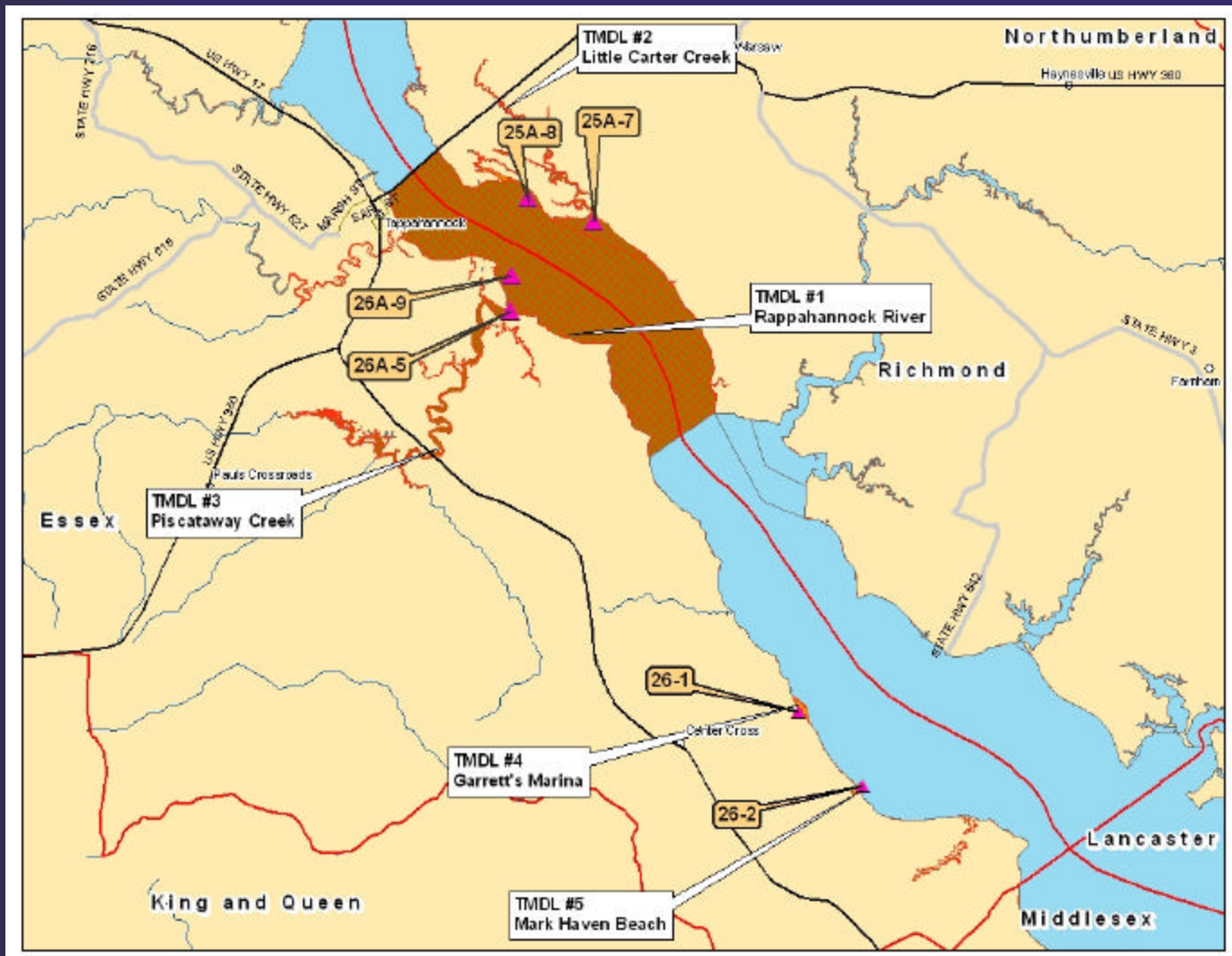
General Permitted Facilities:

Permit Type	Number of Facilities
Construction	8
General	2
Gas Station, Car Wash, etc	3
Total	13

Bacteria Source Tracking (BST)

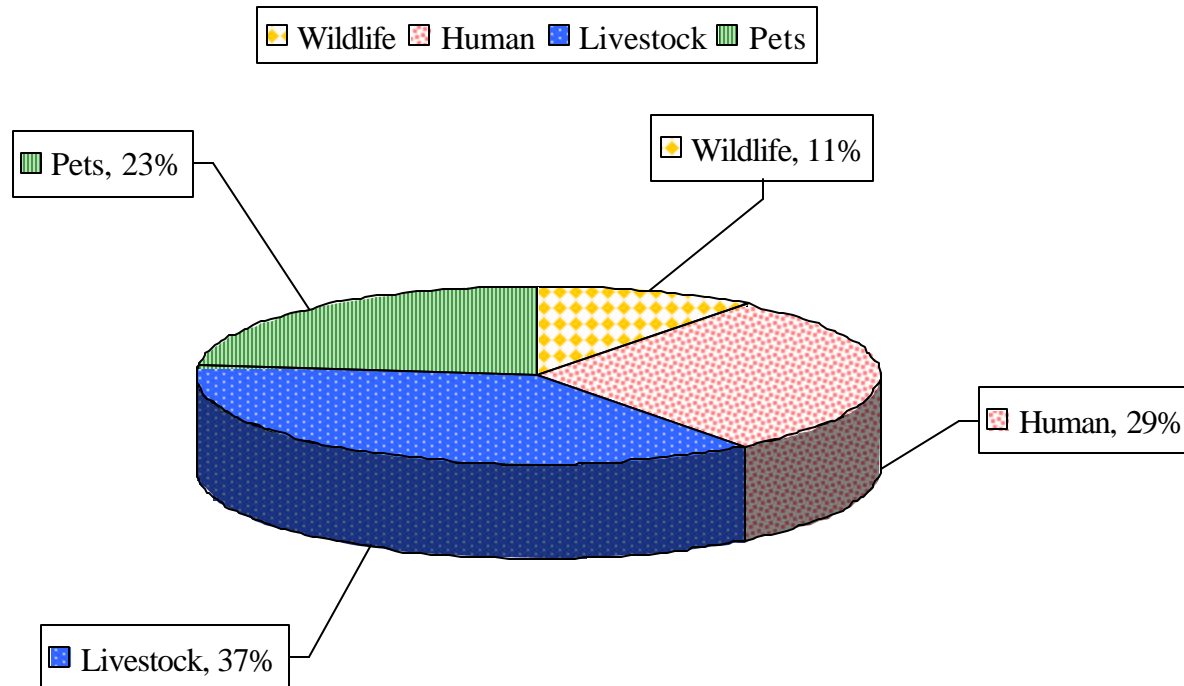
- **BST data were collected at four stations by Virginia Department of Health (VDH)**
 - 2 stations on Rappahannock River Off Little Carter Creek
 - 1 station on Piscataway Creek
 - 1 station on Rappahannock River
 - 1 station at Garrett's Marina
 - 1 station at Mark Haven Beach
- **A total of 12 sampling events at each station**
- **Results indicate that bacteria sources from human, livestock, wildlife, and pet are present in the watershed**
- **The BST distribution will be used to develop the TMDL allocations**

Location of Monitoring Stations for Bacteria Source Tracking (BST)



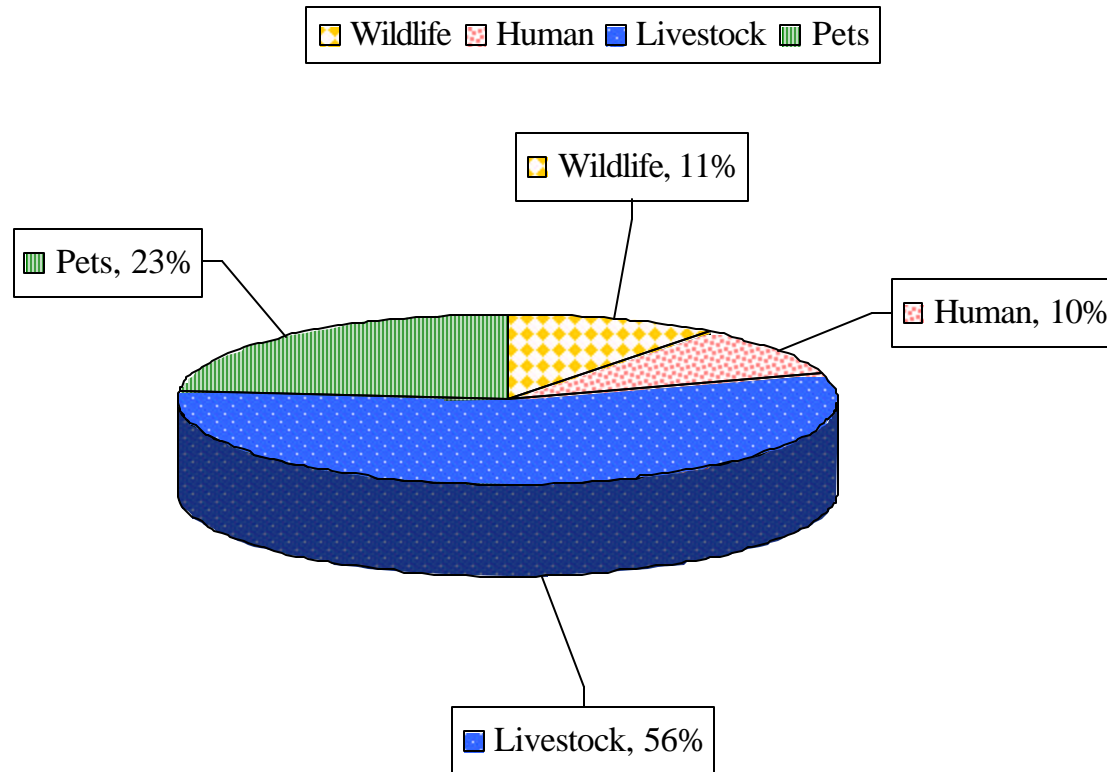
Bacteria Source Tracking, Rappahannock River off Little Carter Creek

Rappahannock River off Little Carter Creek, Station 25A-7



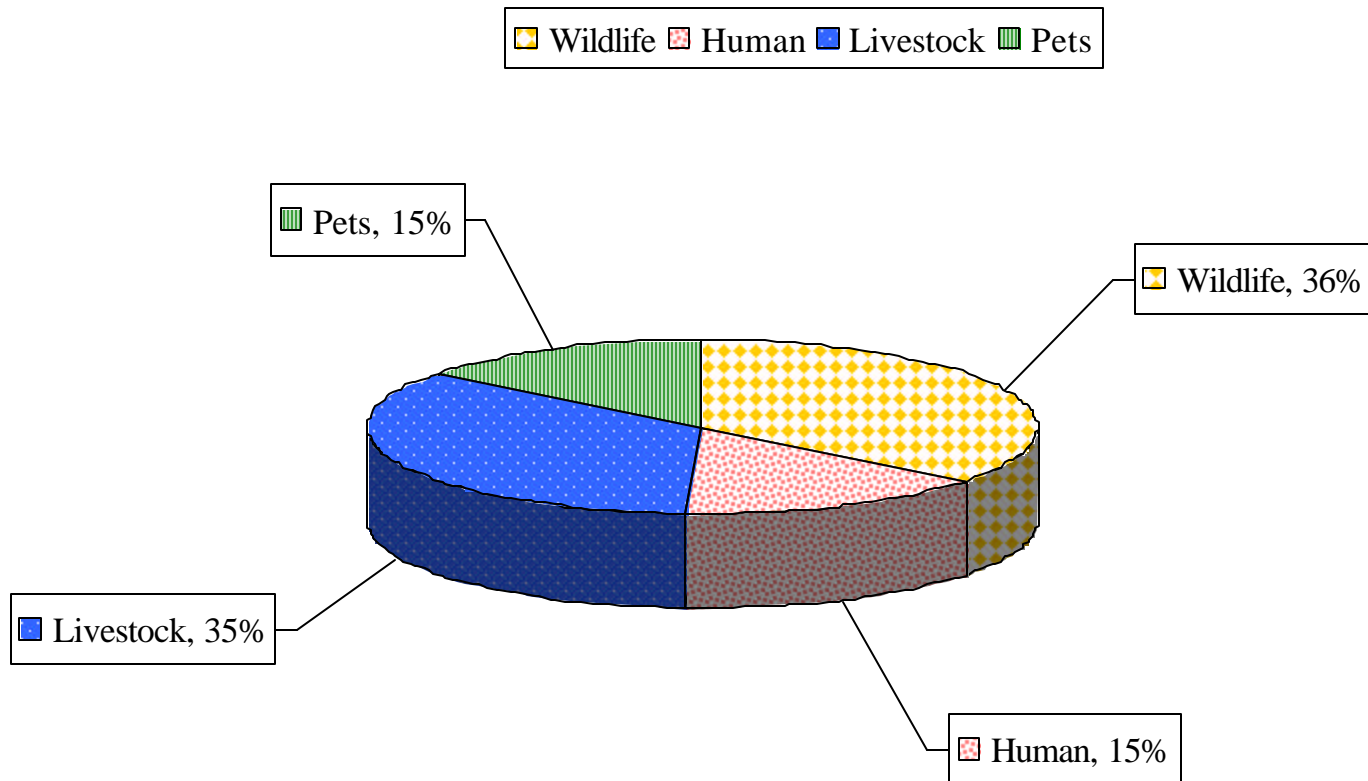
Bacteria Source Tracking, Rappahannock River off Little Carter Creek

Rappahannock River off Little Carter Creek, Station 25A-8



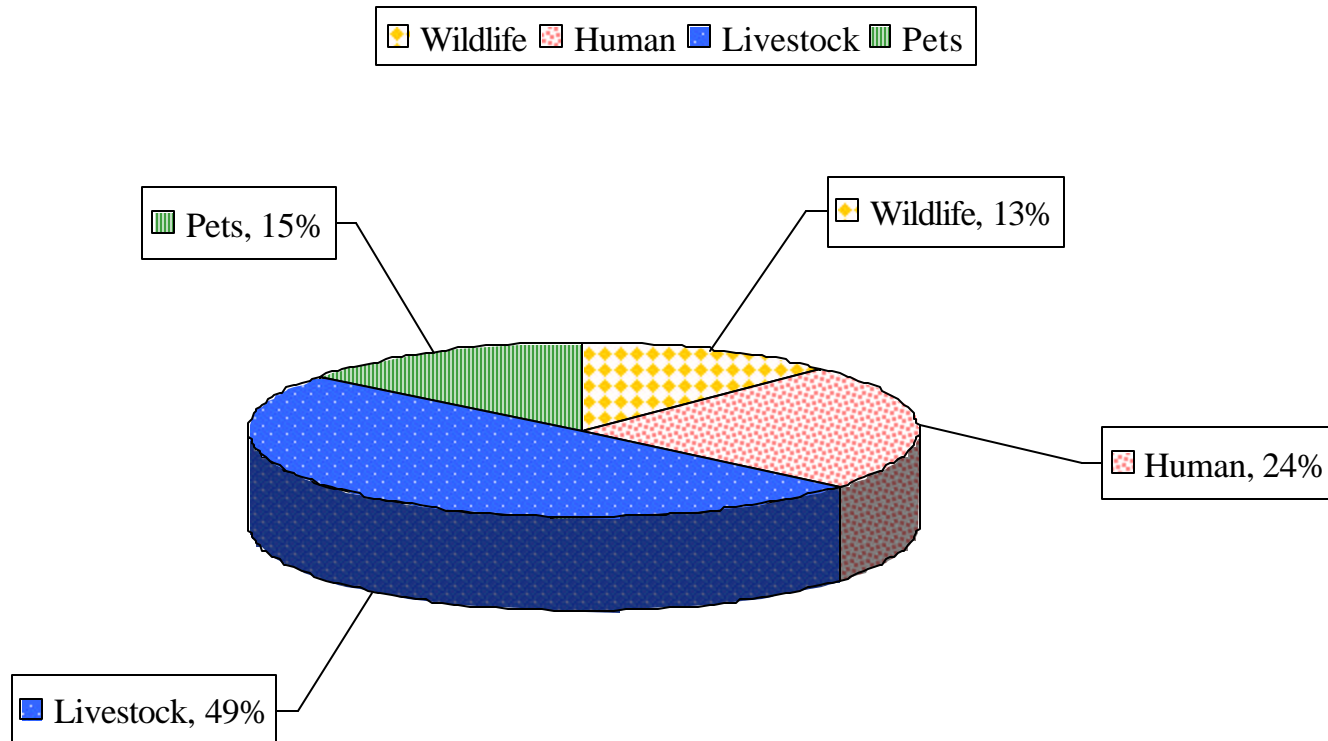
Bacteria Source Tracking, Piscataway Creek and Rappahannock River

Piscataway Creek, Station 26A-5



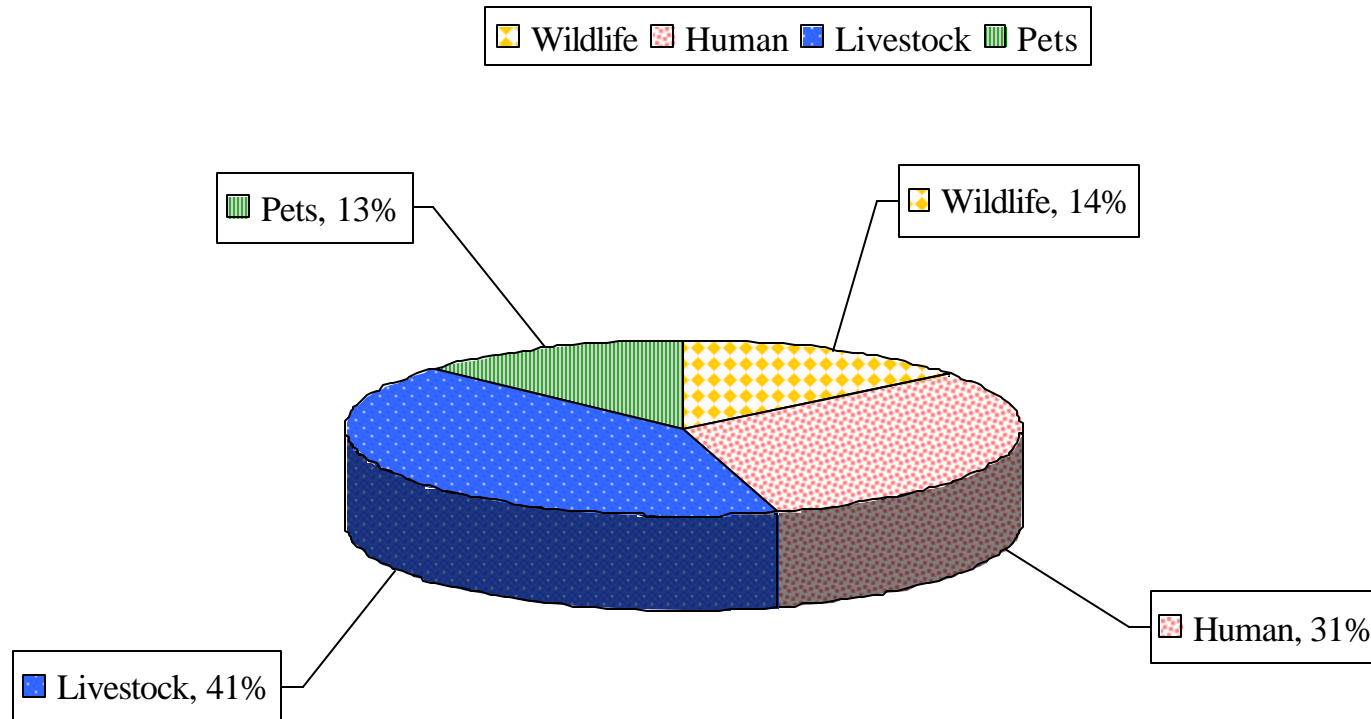
Bacteria Source Tracking, Rappahannock River

Rappahannock River, Station 26A-9



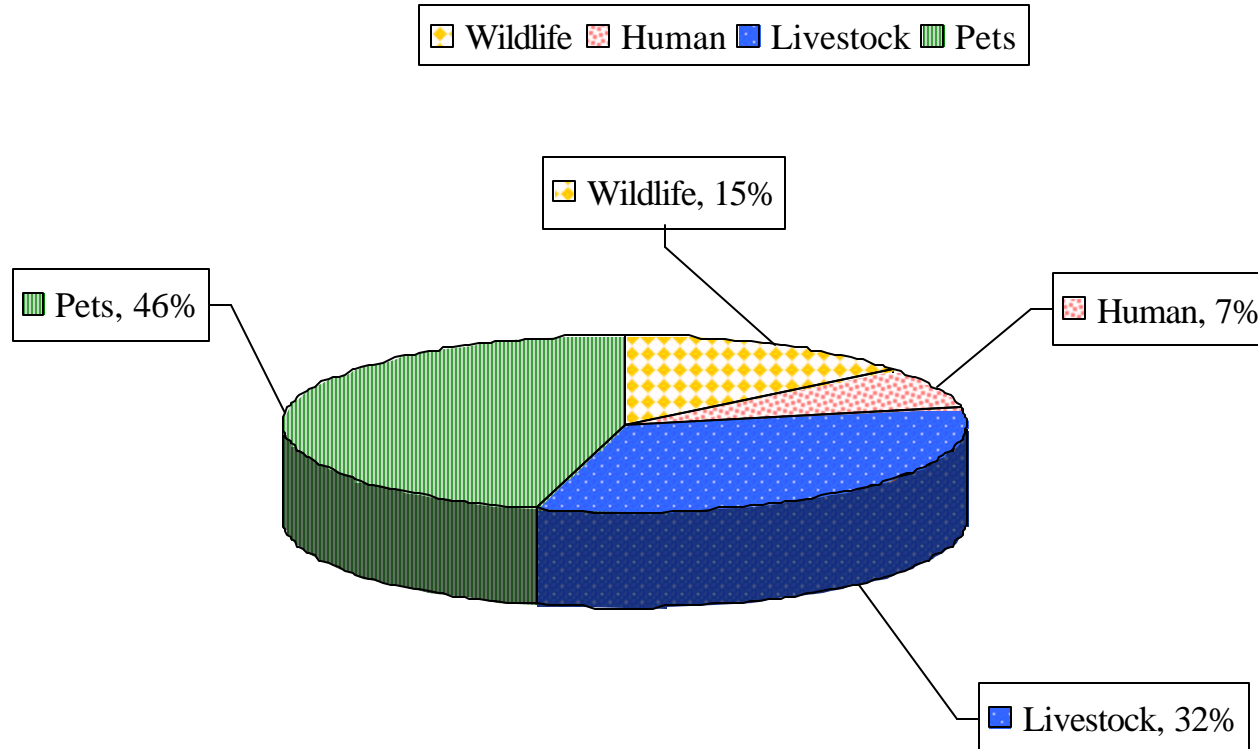
Bacteria Source Tracking, Garrett's Marina

Garrett's Marina, Station 26-1



Bacteria Source Tracking, Mark Haven Beach

Mark Haven Beach, Station 26-2



Bacteria Source Tracking

Table 2-17: Computed Weighted BST Fractions

Station	Wildlife	Human	Livestock	Pets
25A-7	11%	29%	37%	23%
25A-8	11%	10%	56%	23%
26A-5	36%	15%	35%	15%
26A-9	13%	24%	49%	15%
26-1	14%	31%	41%	13%
26-2	15%	7%	32%	46%

TMDL Expression

$$\text{TMDL} = \dot{a} \text{ LA} + \dot{a} \text{ WLA} + \text{MOS}$$

LA = Load allocation (nonpoint source contribution)

WLA = Waste load allocation (point source contribution)

MOS = Margin of safety

Existing Bacteria Source Load

- **Non-point sources for bacteria loads include:**
 - Livestock
 - Wildlife
 - Human
 - Pets

- **Point source for bacteria loads includes:**
 - Town of Tappahannock STP (VA0071471)
 - Haynesville Correctional Center (VA0023469)
 - Montross Westmoreland WWTP (VA72729)
 - Warsaw Aerated Lagoons (VA0026891)
 - Wood Preserver Inc (VA0083127)
 - Wirt Residence (VAG404196)

TMDL Allocation Strategy

- **Load Allocation is based on
BST (Bacteria Source Tracking) data**
- **Waste Load Allocation is based on
permitted flow (design flow) and
bacteria concentration at both point
sources (Town of Tappahannock STP)**

Upper Rappahannock and Unsegmented Estuaries in E23: Source Loading

Source Loading:

Source	BST * Distribution (%)	Existing Load (MPN/day)	Allocated Load (MPN/day)	Required Reduction (%)
Livestock	49%	2.90E+14	2.72E+13	91%
Wildlife	13%	7.69E+13	7.69E+13	0%
Human	24%	1.42E+14	0.00E+00	100%
Pets	15%	8.87E+13	8.31E+12	91%
Total		5.97E+14	1.12E+14	81%

Upper Rappahannock and Unsegmented Estuaries in E23: Waste Load Allocation

Waste Load Allocation (MPN/day)

Point Source	Facility Type	Flow (MGD)	Permitted Monthly Avg (counts/100mL)	Allocated Load (counts/day)	% Reduction
VA0071471	Tappahannock Town of	0.95	200	7.19E+09	-
VA0023469	Haynesville Correctional Center	0.178	200	1.35E+09	-
VA0072729	Montross Westmoreland WWTP	0.13	200	9.84E+08	-
VA0026891	Warsaw Aerated Lagoons	0.3	200	2.27E+09	-
VAG404196	Residence	0.001	200	7.57E+06	-
			Sum of WL from WWTPs	1.18E+10	
			Expansion for Future Growth (5X WLA)	5.90E+10	
VA0083127	Wood Preservers Incorporated	1.16	200	8.78E+09	-
			Total Allocated Waste Load	7.96E+10	-

Upper Rappahannock and Unsegmented Estuaries in E23: TMDL Allocation Plan Loads

TMDL Allocation Plan Loads (MPN/day)

WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
7.96E+10	1.12E+14	IMPLICIT	1.12E+14

Piscataway Creek Source Loading and Draft TMDL Allocation

Source Loading:

Source	BST * Distribution (%)	Existing Load (MPN/day)	Allocated Load (MPN/day)	Required Reduction (%)
Livestock	35%	2.38E+13	1.13E+10	100%
Wildlife	36%	2.44E+13	4.91E+12	80%
Human	15%	1.02E+13	0.00E+00	100%
Pets	15%	1.02E+13	4.83E+09	100%
Total		6.86E+13	4.92E+12	93%

No Waste Load Allocation

TMDL Allocation Plan Loads (MPN/day)

WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
0.00E+00	4.92E+12	IMPLICIT	4.92E+12

Little Carter Creek Source Loading and Draft TMDL Allocation

Source Loading:

Source	BST * Distribution (%)	Existing Load (MPN/day)	Allocated Load (MPN/day)	Required Reduction (%)
Livestock	37%	3.11E+12	5.18E+10	98%
Wildlife	11%	9.24E+11	9.23E+11	0%
Human	29%	2.44E+12	0.00E+00	100%
Pets	23%	1.93E+12	3.22E+10	98%
Total		8.40E+12	1.01E+12	88%

No Waste Load Allocation

TMDL Allocation Plan Loads (MPN/day)

WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
0.00E+00	1.01E+12	IMPLICIT	1.01E+12

Garrett's Marina Source Loading and Draft TMDL Allocation

Source Loading:

Source	BST * Distribution (%)	Existing Load (MPN/day)	Allocated Load (MPN/day)	Required Reduction (%)
Livestock	41%	4.78E+11	2.28E+10	95%
Wildlife	14%	1.63E+11	1.63E+11	0%
Human	31%	3.61E+11	0.00E+00	100%
Pets	14%	1.63E+11	7.79E+09	95%
Total		1.17E+12	1.94E+11	83%

No Waste Load Allocation

TMDL Allocation Plan Loads (MPN/day)

WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
0.00E+00	1.94E+11	IMPLICIT	1.94E+11

Mark Haven Source Loading and Draft TMDL Allocation

Source Loading:

Source	BST * Distribution (%)	Existing Load (MPN/day)	Allocated Load (MPN/day)	Required Reduction (%)
Livestock	32%	1.14E+11	5.69E+09	95%
Wildlife	15%	5.34E+10	5.33E+10	0%
Human	7%	2.49E+10	0.00E+00	100%
Pets	46%	1.64E+11	8.18E+09	95%
Total		3.56E+11	6.72E+10	81%

No Waste Load Allocation

TMDL Allocation Plan Loads (MPN/day)

WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
0.00E+00	6.72E+10	IMPLICIT	6.72E+10

Next Steps

- **30 day comment period (January 19th, 2010)**
- **Final TMDL Report**

TMDL Contacts



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